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FIELD HUSBANDRY AND GENERAL COURSE

OF

CORRESPONDENCE SCHOOL OF SCIENTIFIC FARMING OF WESTERN CANADA LIMITED

WINNIPEG, MAN.

LESSON XVB.

FARM MACHINERY. — Seeding, Harvesting and Threshing Machinery discussed in detail. Different kinds of Seeders and their Adaptability for different Classes of Soils. How to Run a Binder Successfully. Intricate Working of the Seperator or Threshing Machine Outlined in Simple Terms.

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SEEDING MACHINERY

CHAPTER I.

The yearly cycle of farm operations commence in the fall and spring by preparing the seed bed with the various implements of tillage. These implements have been described in Lesson V., which is devoted to the subject of tillage. In this lesson we shall, therefore, discuss the construction, operation, adjustment, care and repair of the various farm machines, taking them up in the order they are used on the farm and beginning with seeding machinery.

CLASSIFICATION OF SEEDERS AND DRILLS.

Broadcast Seeders—

1. Hand rotating distributor.
2. Endgate rotating distributor.
3. Wheelbarrow seeders.
4. Wheeled broadcast seeders.
   (a) Wide track.
   (b) Narrow track.

[illegible]ination cultivator and disc seeders.

Drills—

1. Hoe.
2. Shoe.
3. Single disc.
4. Double disc.

Covering Devices—

1. Chains.
2. Press wheels.

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Feeding Mechanisms—

1. Agitator feed.
2. Force feed.
   (a) Single run.
   (b) Double run.

Hand Seeder.—The hand seeder shown in Fig. 1 has a seed distributor consisting of a flat disc with radial flanges. The seed drops through an adjustable hole in the bottom of the bag down upon the rapidly revolving distributor (Fig. 1) by which it is

Fig. 1
Old Fashioned Hand Seeder, Usually Strapped to Operator's Shoulders.

scattered in all directions by the centrifugal force generated. The machine is usually strapped to the operator's shoulders so as to give him the free use of his hands for operating the machine. The amount of seed sown is gauged by regulating the size of the opening in the bottom of the sack, by the rapidity with which the sowman rotates the distributor and by his rate of travel. This machine finds a limited use in sowing turnip and similar

seeds broadcast and may also be used for sowing grass seeds when the regular drill used on the farm is not provided with a grass-seed attachment. It is used quite extensively for sowing bromus. This seed is very light, weighing approximately 14 pounds to the bushel, and being shaped somewhat like oats is difficult to sow uniformly in an ordinary drill, even when mixed with the seed of a nurse crop. With a little practice good results may be obtained when sowing it with the hand rotating distributor. When this is done the nurse crop, if used, should be sown first with an ordinary drill when the wheel tracks will form convenient guides in sowing the bromus. When sowing with this machine choose as calm a day as possible so that the seed may scatter uniformly. The seed should afterwards be covered by light harrowing.

Endgates Rotating Distributor.—The endgate rotating distributor, illustrated in Fig. 2, is similar in design and construction to the hand rotating distributor. It is designed to be attached to the rear of a common farm wagon. A sprocket wheel is bolted to the inner side of one of the rear wheels of the wagon from which the distributor is rotated by means of a chain. This type of seeder lends itself to the same uses as the hand machine and because of its cheapness and convenience was used quite extensively in some localities when broadcasting was the common method of seeding. Since the advent of the drill its use has become quite limited, although it is still listed by many manufacturers.

Fig. 2
Endgate Rotating Distributor, attached to rear of common Farm Wagon.

Wheelbarrow Seeder.—The wheelbarrow seeder is said to have originated in China, where it has been used for ages, and it is still the most common type of seeder in that country. A good idea of its general construction and operation may be obtained from Fig. 3, which illustrates a modern

Fig 3
Wheelbarrow Seeder, commonly used by Market Gardeners.

machine of this type, such as is commonly used by market gardeners. In order to secure uniform seeding and prevent the clogging of the seed openings, the seed is agitated by a slide in the bottom of the hopper which is vibrated by connecting arms struck by the spokes of the wheel as it revolves.

Wide Track Broadcast Seeder.—The wide track broadcast seeder is mounted on two wheels between

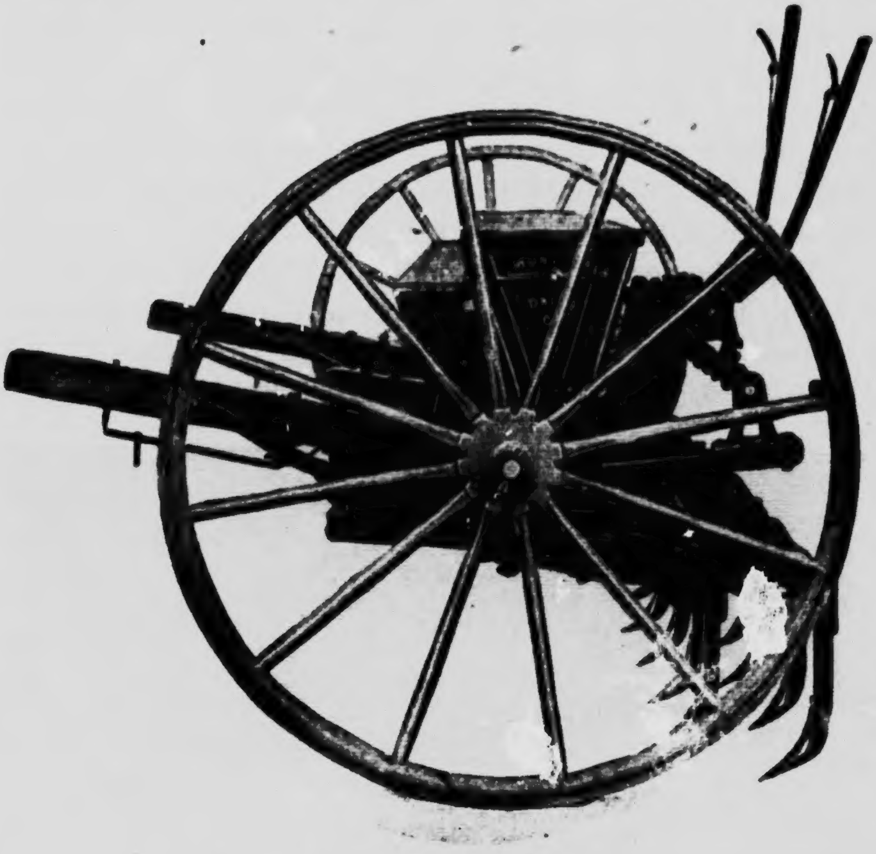

Fig. 4
Wide Track Broadcast Seed.

which is supported the frame carrying the seed box and covering devices together with other mechanism and parts of the machine. The seeder illustrated

by Fig. 4 is representative of this type of machine. In some makes the agitator feed is used while the better ones employ the more reliable force feed mechanism shown in Fig. 15. The seed is commonly conveyed in tubes to within a few inches of the ground and each tube is followed by a common cultivater shovel which covers the grain. These machines do not seed and cover at an even depth, as some of the grain gets into the deep furrows made by the shovels while some of it remains entirely uncovered. At present the broadcast seeder has been practically superseded by the drill and is but little used in any form in the large grain-raising sections of Canada and the United States.

The Narrow Track Seeder.—The narrow track seeder, Fig. 5, is similar in design and construction to the wide track machine except that the wheels are placed as closely together as on a wagon. As

Fig. 5
Narrow Track Seeder, similar in design and construction, to Fig 4.

shown in the illustration the seed box extends beyond the wheels on both sides dragging a marker at either end for a guide in sowing. Narrow track drills are also manufactured by several companies.

The narrow track machines are used advantageously on rough, uneven ground containing stones or other obstructions. A wide track machine is difficult to guide under such conditions, for the wheels in passing over obstructions or dropping into hollows cause the tongues to whip the shoulders of the horses producing chafing and much discomfort. The narrow track machine is obviously much easier to guide and is designed to meet the conditions described.

Drill and Disc Harrow.—A combination drill and disc harrow is illustrated in Fig. 6. This type of machine is also made in the form of a broadcast seeder and is designed to do the work of a disc harrow as well as a seeding machine, but, as a rule,

Fig. 6
Combination Drill and Disc Harrow.

has not been found especially efficient in its capacity as either. If the discs are to be so shaped and adjusted that the machine is efficient as a tillage implement, its draft becomes too great unless made

narrow. As a seeder it sows unevenly, some of the grain dropping into the deep, narrow furrows made by the discs while many kernels scatter on the surface. An uneven stand of grain is usually the result.

Drills.—The idea of sowing grain in drills or rows was not originated when a few decades ago the drill commenced replacing the broadcast seeder as a seeding machine but is as old as agriculture. Records show that the Assyrians used a crude single row machine for sowing grain as early as 500 B.C. In 1731 Jethro Tull, of England, published a book entitled "Horse Hoeing Husbandry," wherein he sets forth the advantages of drilling over broadcasting and constructed several machines to sow the grain in this way but, on account of the mechanical defects, drills were not a marked success until the advent of the modern machine with its accurate force feed mechanism. A modern drill with shoe furrow openers is shown in **Fig. 7**.

Fig. 7
Modern Drill with Shoe Furrow Openers.

Furrow Openers.—This is the name commonly given the devices placed on drills for opening small furrows in which the seed is sown. In the matter of furrow openers, the manufacturers have been unable to produce a type that will do perfect work in any soil. They have found it necessary to place upon the market a number of varieties so that one of them may suit the soil condition in any section where grain is raised. A number of standard furrow openers has been the result. The hoe drill succeeded the broadcast seeder, and in spring-wheat seeding, especially, the shoe drill superseded the hoe drill, so that at present the the latter has become practically obsolete. Later single-disc and double-disc drills were introduced and each is unquestionably the best for some localities.

Hoe Drill.—The hoe drill, shown in Fig. 8, consists of a pointed hollow tube or boot through which the grain passes to be deposited in the furrow made

Fig. 8
Sample of Hoe Drill

by the sharp point. To prevent breaking when the point strikes stumps or other obstructions, the hoe is usually provided with break pins similar to those

sometimes used on cultivator shovels. The figure shows a spring break which serves the same purpose and is more convenient as the hoe springs back into place as soon as the obstruction is passed. The tension of the spring is usually made adjustable.

Farmers who have had experience with various soils know that while the hoe furrow opener has good penetration it will not do satisfactory work in ground filled with long stubble or trash of any kind. It does fair work in a clean, well prepared seed bed, but will not sow at as even depth as the other types and is not to be compared with them.

Shoe Drill.—The shoe drill dates back to 1866, but it was not perfected or extensively used until 1885 when its advantages began to be recognized and it became adopted throughout the grain-raising sections of the world. As shown in Fig. 9, the shoe

Fig. 9

The Shoe Drill, which has been in extensive use for the last 25 years.

is so shaped as to open a V-shaped furrow into which the grain is deposited through a hole in the heel of the shoe. The shoe has the advantage over the hoe that in avoiding the accumulation of trash the depth of sowing can be better regulated;

neither has it the bobbing motion characteristic of the hoe, and, therefore, greater uniformity of depth is obtainable. The shoe is forced into the ground by means of a spring. There are two types of springs used, viz., the coil wire spring and the rod or bar spring. The rod or bar spring is shown in Fig. 9. It is apparent that the greater the resiliency of these springs the more perfect will be the uniformity of depth in passing over uneven ground. Coil springs, if of sufficient length, are quite effective but, although they are used on a majority of drills, some makers claim that the bar spring permits the shoe more independent action without material variation of pressure and that they do not lose their tension and elasticity as the coil springs sometimes do.

The shoe drill will not do satisfactory work in hard ground or in clay ground which bakes in lumps. The shoe drill does good work in a clean seed bed that has been thoroughly loosened and pulverized by harrowing. It is not as good as the disc opener for sowing wheat in stubble ground, a common practice where winter wheat is sown after spring crops, neither is it a success on corn stubble. It has the advantage of simplicity over the disc openers as it has no bearings, requires less care, and lasts longer.

Single Disc Drills—These are of two types—those with flat discs and those with disc-shaped discs. The straight disc opens a narrow V-shaped furrow similar to that made by the shoe while the disc-shaped variety opens a wider furrow into which the grain is distributed, thus giving the grain a better chance to stool out and secure a better root

development than is possible where it is crowded into a narrow furrow. The draft of the latter type is, however, greater as it requires more power to open the wide furrows and besides it does considerable work in pulverizing the soil and preparing the seed bed.

The single disc has more penetration than the other forms of furrow openers and is, therefore, especially well suited for hard and trashy ground. The discs are usually made dished, like those of a disc harrow, so that they do considerable work in pulverizing the soil and in preparing the seed bed while the others do little but merely sow the grain. On this account one would naturally expect the draft of the single disc to be greater than that of the double disc and such is the case. The following results of draft tests taken in the same field, on the same day, at the North Dakota Experiment Station, will prove this point:

Kind of disc	Distance apart of rows	Number of discs	Distance covered in feet	Total Draft in pounds	Draft per foot
Single	6"	22	11	850	77.27
Double	6"	22	11	675	62.27

Some of the objections to the single disc are: First, it tends to make the ground uneven since the soil is thrown in only one direction and is left in ridges but to compensate for this it leaves the soil in better tilth than any other form. Second, there is a tendency for the disc to clog in wet, sticky soil. Third, its weak point is its bearing.

In buying a single disc pay particular attention to the disc bearings, examine them as to their dust-proof qualities and convenience of lubrication. Further, select a drill with the heel or auxiliary shoe of such form that it will not clog. Don't buy

a single disc drill that allows the seed to come in direct contact with the discs as they will scatter the seed. An enclosed boot should be provided to lead the seed into the bottom of the furrow before the earth is permitted to fall back into the furrow. In spite of some of the objections raised against the single disc, it will meet more of the many and varying soil conditions to be encountered than any other form of furrow opener and for this reason has become very popular.

The single disc furrow opener is illustrated in Fig. 10.

Fig. 10
Single Disc Drill with Boot to lead Seed into bottom of furrow.

Double Disc—The double disc, clearly illustrated in Fig. 11, is the latest type of furrow opener. The boot and axles are commonly made in one solid casting to which the draw bar is attached. The disc axles are usually cone shaped, and are placed at such angle with each other as to bring the flat discs close together in front forming a single edge. This brings the discs about $2\frac{1}{4}$ inches apart in the rear and about $1\frac{1}{2}$ inches apart at the bottom. The

discs revolve together and being bevelled at the edge tend to wear sharp which enables them to effectively cut through trash and open a clean furrow for the seed.

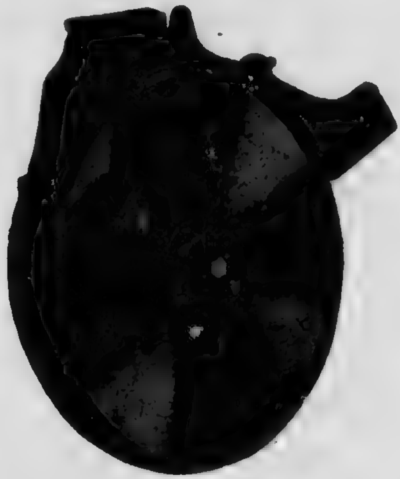

Fig. 11
The Double Disc.

The double-disc drill is lighter in draft than eithed the shoe or single-disc, and this is one reason for its great popularity. It has not the penetration

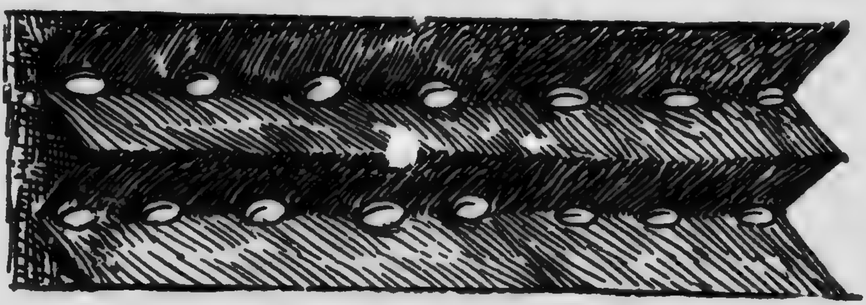

Fig. 12
Double Furrow left by use of Double Disc Drill.

power of the single-disc, and will consequently not do as good work on hard, trashy ground, although it is by far the best furrow opener on corn stubble

ground. When used on soil well pulverized and in good tilth, it is undoubtedly the best furrow opener on the market. The double-disc sows the seed in a wider furrow than the other types—in fact, it produces a double furrow, as shown in Figure 12, with a single ridge between, so that the grain is sown in two rows instead of one. This is claimed to be a great advantage by many, who maintain that it gives the plants more root room. The double-disc has a better bearing than the single-disc, and with equal care and wear should last longer. In general, a double-disc will do good work on soil on which a shoe drill has been successful, but it has not the wide range of adaptability possessed by the single-disc. In the right kind of soils it is the best furrow opener and should be used in many localities where the single disc is at present used almost exclusively. The double-disc is the most expensive furrow-opener to manufacture, and, being sold at the same price, must consequently be sold at a lower profit than the other types. For this reason, agents seldom urge their patrons to buy this type, although companies furnish it on demand.

In buying a drill, the farmer should determine which type of furrow opener is best suited to his soil conditions, and demand that type.

Covering Devices.—The common method of covering the seed is by means of a chain composed of large iron rings, connected with small links. attached behind each furrow opener. The drill shown in Fig. 7 is equipped with covering chains which do the work satisfactorily under ordinary soil conditions.

Press Wheels.—When the soil is loose and dry, quicker and more certain germination of the seed

is secured by pressing the soil firmly over the seed, which improves the soil capillarity so that the moisture will be drawn from beneath and sprout the seed. This is accomplished by press drills which

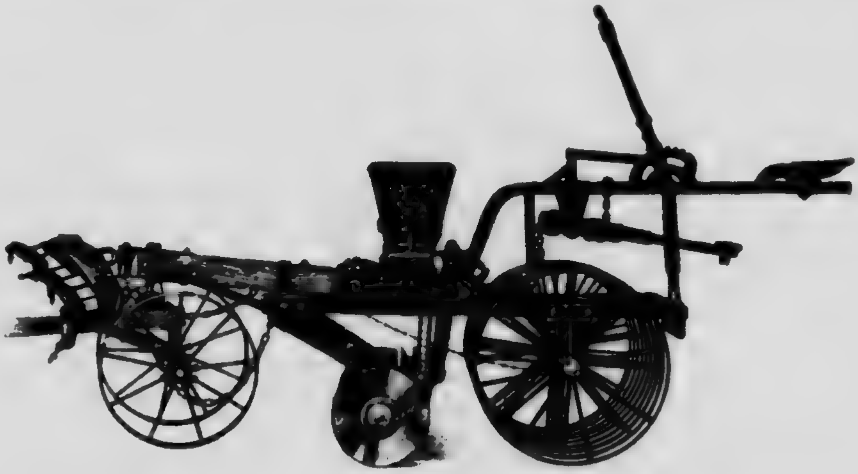

Fig. 13
Good Type of Press Drill.—Operator's weight gives additional pressure to the wheels.

do good work in a loose, well-prepared- seed-bed, but on hard ground most of the weight of the machine must be used in securing proper depth for the furrow openers, and the remainder of the weight being distributed on all the press wheels the pressure on each must be relatively small. Figure 13 shows a good type of press drill, so arranged that the weight of the operator gives additional pressure to the wheels. The tongue truck used on this machine is a very desirable feature, as it relieves neck weight, and no press drill of this type should be bought without a tongue truck.

Press Wheel Attachments.—The press wheel attachments, as shown in Figure 14, are made by many manufacturers, and may be attached to a

standard high-wheel drill instead of the covering chains. No other pressure should be applied to such an attachment than that resulting from the weight of the operator and of the attachment itself, unless

Fig. 14

Press Wheel Attachment used with Standard High Wheel Drill, instead of covering chains.

a tongue truck is provided to relieve the horses from the added neck weight. One objection to many press-wheel attachments is that they are difficult to

turn with because the castings are liable to be broken in making short turns. In the attachment shown in Figure 14, this difficulty is overcome by attaching the wheels in pairs so that a short turn may be made as shown. Springs are provided for each pair of wheels which insure flexibility and uniformity of pressure in passing over uneven ground.

Feeding Mechanism.—This is one of the most vital parts of a seeding machine, and must be of such design and so calibrated that it may be set to accurately sow the different varieties of grain in amounts ranging from a small fraction of a bushel to several bushels per acre. Manufacturers of seeding machinery, in their attempts to solve the problem of even and accurate sowing, have developed two types, viz., the agitator-feed and the force-feed.

The Agitator Feed consists simply of openings in the bottom of the seed hopper over each grain conveyor, through which the seed drops by the action of gravity. The size of these openings is regulated by means of slides operated by a lever, whose quadrant is calibrated to indicate the amount of different varieties of seed which will be sown per acre with the lever in the different notches. This type of feed derives its name from a series of corrugated wheels which, revolving in a shaft in the seed hopper immediately above the seed openings, agitate or stir the seed to prevent clogging and to secure uniformity of sowing. The agitator feed is not as accurate as the more recently developed force feed, and has been almost entirely replaced by it.

The Force Feed is so arranged that the seed is forced into the seed openings in a continuous flow, which, when properly adjusted, produces the rate of

seeding per acre that is desired. It is more positive in its action than the agitator feed, and is less liable to become clogged by foreign substances in the seed or when the seed is damp from treatment for smut.

There are two standard types of force feed mechanisms on the market—the single run and the double run.

The Single Run force feed mechanism is illustrated in Figure 15, and consists essentially of a small iron hopper, one for each furrow opener, placed on the under side of the grain box. A square feed shaft passes through the hoppers and

Fig. 15
Single Run Force Feed Mechanism well illustrated.

carries a set of fluted or corrugated cylinders When the machine is operated the seed gets into the flutes and is forced down into the grain conveyor. The amount of seed sown is regulated by sliding the cylinder in or out of the hopper. When the cylinder is entirely inside the hopper, as shown in the right of Figure 15, the drill sows the maximum amount. The feed shaft is shifted by a convenient lever, so that the cylinders may be shoved in or out as desired. A calibrated plate indicates the amount of the different grains sown when the lever is placed at various positions. In order that their drills may sow

peas, beans and other large seed, some manufacturers have made the flutes in the feed cylinders so large and deep that they sow wheat and smaller grain in bunches in the row, instead of distributing the seed evenly, as is done with smaller and more numerous flutes. It is better to buy a drill that will sow the staple crops perfectly, although large seed cannot be sown with it, than to sacrifice even sowing for the sake of having a machine that will handle more varieties.

Fig. 16

Double Run Force Feed consists of an Iron Hopper inside of which a wheel with flanged rim revolves.

The Double Run force feed is especially well adapted where a large variety of grain is to be sown, and is the best type to buy if it is to be used for sowing peas, beans, corn, etc., as well as wheat and smaller grains. As shown in Figure 16, it consists of an iron hopper, inside of which revolves

a wheel having a flanged rim There are small ribs or cogs cast on the inside of the flanged rim, which engage the seed and force it through the seed opening. The wheel divides the hopper into two compartments, one being for wheat and small grains, the other for oats, peas, etc. A lid hinged over the middle of the hopper closes the side that is not in use. The corrugations on the wheel as well

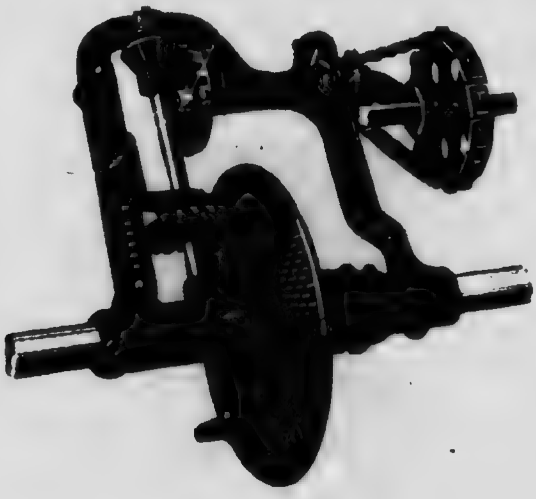

Fig. 17

Speed Plate which regulates speed of Seed Shaft, and, consequently, amount of Seed sown.

as the seed opening are larger on the side sowing the coarser grains. The amount of seed sown is regulated by varying the speed of the seed shaft, which is accomplished by means of a speed plate shown in Figure 17. The face of the speed plate consists of thirteen or more cog circles, any one of which may be engaged by a small pinion whose different positions are calibrated to show the rate of sowing.

Interchangeable Parts.—Nearly all manufacturers now make their drills with interchangeable parts so that any type of furrow opener made by the company may be put on their machines. This is a great convenience when it is desired to use another furrow opener, as it does not necessitate the purchase of an entirely new machine.

Grass Seed Attachments.—The feed cups of the ordinary drill, being designed to sow relatively coarse seed, do not sow fine grass seeds as accurately as is necessary to secure an even stand. Then, too,

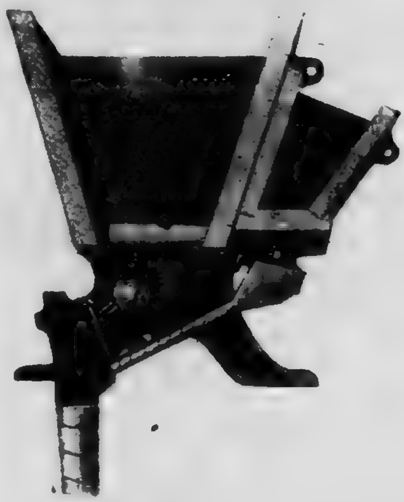

Fig. 18
Grass Seed Attachment.

many grass seeds are so expensive that it becomes a matter of considerable economy to secure such an even distribution of the seed that the minimum amount per acre will suffice. Grass seeds are often sown with a nurse crop, but the best results cannot be secured by mixing the seed with that of the nurse crop and sowing it with a grain drill. There is a field, then, for a reliable grass seeder, and to meet

this demand manufacturers of seeding machinery have perfected a grass seed attachment for their machines. As shown in end section in Figure 18, it consists of a small seed hopper with feed shaft and cups similar to, but smaller, than those of the main drill. The seed conveyors are spouted into the main conveyors as shown, but if the nurse crop is sown at a greater depth than is desirable for the grass seed, the grass seed conveyor spouts may be hung straight down, when the grass seed will be sown broadcast. These attachments, when well made, are a desirable auxiliary on a grain drill, and on a farm where grasses form part of the farm crops, a drill is not complete without it.

The Frame.—Some otherwise excellent drills now on the market fail because the frame is too weak to support the machine without sagging. Considerable strain is placed on the frame of a large drill, and it must be strongly built and well trussed. Massiveness and quantity of material used in a frame do not always signify strength. The material in a seemingly light frame may be of such quality, and the frame is so well designed, that it will support a heavier load than another frame where much more material is used but so placed that the best use is not mode of its strength. Lightness as well as strength must be a feature of the ideal machine. In contemplating the purchase of a drill, do not fail to examine its frame construction, and observe, if possible, a drill of the same make that has been in use for several years—its condition will tell more than can be learned from the new machine.

Distance Between Furrow Openers.—The distance between furrow openers in drills varies from four to eight inches, and in some makes of drills designed for dry farming sections, they are far

enough apart so that the crop may be cultivated during the growing season with a common cultivator. For Canada and the spring-wheat sections of the United States, a distance of six inches between furrow openers is the most common, and it has been demonstrated that this distance produces on the average larger yields than when the furrow openers are closer or farther apart.

CHAPTER II.

HARVESTING MACHINERY

Of the large retinue of mechanical serfs at the command of the farmer to-day, the self-binder is, perhaps, the most important. Its place could not be filled by a score of men with cradles and rakes, and, if properly managed, it has a greater efficiency and is much more subservient to the master's will than the human slave of old. Since the early history of the binder, the necessity of greater efficiency and capacity has steadily increased. Not only is the cost of labor greater, but the new soil farmed at that time produced a strong, healthy straw that stood up well when ripe, and a delay in harvesting was not so serious. At present, on account of the ravages of rust and other diseases, the straw often breaks badly even before the grain is ripe, so that the profit of a crop is often dependent upon the despatch with which it is harvested.

The neglect and abuse to which binders are often subjected, notwithstanding the fact that the success of an entire year's work may depend upon them, is proverbial. It is not uncommon to see a binder stored away in the corner of a field where it was last used, or in some exposed part of the yard, with the twine-box full of expensive pure Manilla twine and the reel hoisted as high as possible, as if it were desirable to have it thoroughly exposed to the breeze. By the time it is to be used again the master-wheel will probably have sunk deep into the

soil; while the pole and neck-yoke are allowed to rest on the ground. Nature, as if ashamed of the deplorable shiftlessness of its co-partner, will often hide the evidence of his neglect by a luxuriant crop of weeds.

Under these conditions, it is small wonder that the **average life of a binder is short.** While the farmer complacently measures its life in years, its real usefulness may be counted in days. A binder is used on the average not much more than two weeks a year, and lasts about five years, which gives it a period of usefulness of approximately 70 to 100 days. That this time could be indefinitely increased by better care and management, and that neglect and mismanagement result in short-lived machines, improper work, and large expenses for repairs, is obvious.

Considering the high price of binders, together with their comparatively short life and the short time that they are used each year, few better investments can be made by a farmer than that of providing adequate shelter.

The Best Time To Repair Binders.—Before binders are put away after a season's work, they should be gone over with the same care that a good engineer would bestow on his engine. All old grease and dirt should be removed from the surface, as well as from the bearings. This can be done with kerosene and waste. The binder should be carefully oiled, and all bright parts greased to prevent rusting. After the season's work is over is also the proper time to repair and overhaul the binder for next year. At this time the operator knows, or should know, all the defects of the machine and what it needs in the line of extras and repairs to refit it for next season's work. If the machine is put

away, on the other hand, without being given a second thought until needed again, the operator, if he still remains on the place, will have forgotten what the machine most needed. The result is that the binder is, perhaps, given a hasty inspection, which in the majority of cases fails to reveal anything, and brought out into the field with numerous small defects that could have been repaired at a nominal expenditure of time and money. If the farmer is too busy to attend to repairs immediately after the season's work is completed, he should at least find time to do the next best thing, which is to make a thorough note of all defects of the machine with a view to remedying them when time is more plentiful.

Binders are often operated by inexperienced or careless persons, who, knowing nothing about the machine they are using, sit serenely in the seat and do nothing but drive. Such men are as surely out of place as they would be on an engine platform. A binder operator should be familiar with and understand the function of every part of his machine, and what is more, he should be able to make all necessary adjustments and repairs without the aid of an expert. He must know where to oil, when to oil, and how to oil. Many a good binder has been prematurely relegated to the scrap pile because of improper oiling. The man who gives his binder an oil bath when starting and then fails to oil again until it fairly screams for more, may succeed in using a great deal of oil, but his binder will soon wear out. All oil that does not get into the bearings does more harm than good, as it serves to gather dust and grit which will work into the bearings. The proper way

to oil is to use a little at a time and often. All parts of a binder do not need the same amount of oil, and the operator should decide which parts, by virtue of their work, need the most, and give them frequent oiling, while other parts may require only occasional applications.

There is a tendency among farmers to discard a machine before its usefulness is ended, and not infrequently is a binder thrown away that, with a few dollars' worth of repair, would still give efficient service. A farmer should, therefore, be enough of a mechanic to know when a machine is worn out and when it would pay to overhaul and repair it.

Tools Required.—In order to enable the operator of a binder to make proper repairs, the following tools should be found in the tool box of every binder in the field. One or two good casting wrenches of such size as to fit most nuts on the binder, one monkey-wrench or pair of pliers, at least one good cold-chisel, a punch, a drift for driving out keys, and a light mechanic's hammer. Equipped with these tools and a desire to thoroughly understand his binder, any person of average intelligence can soon learn to detect the difficulties and make all the necessary adjustments and repairs.

Figure 19 illustrates a modern side-cut self-binder equipped with roller bearings, open elevator, tongue truck, and such other auxiliaries as have been found efficient and desirable on a binder. This type of binder is made in 6, 7 and 8-foot cuts, and is constructed almost entirely of steel and malleable iron. Lack of space forbids a detailed description of the machine, and it will be necessary to pre-suppose a

previous knowledge of the machine on the part of the student; or, lacking this, that he will seek out a machine and familiarize himself with its construction and the rudiments of its operation. This discussion will be limited to a consideration of the vital parts of the binder—their repair, care and adjustment.

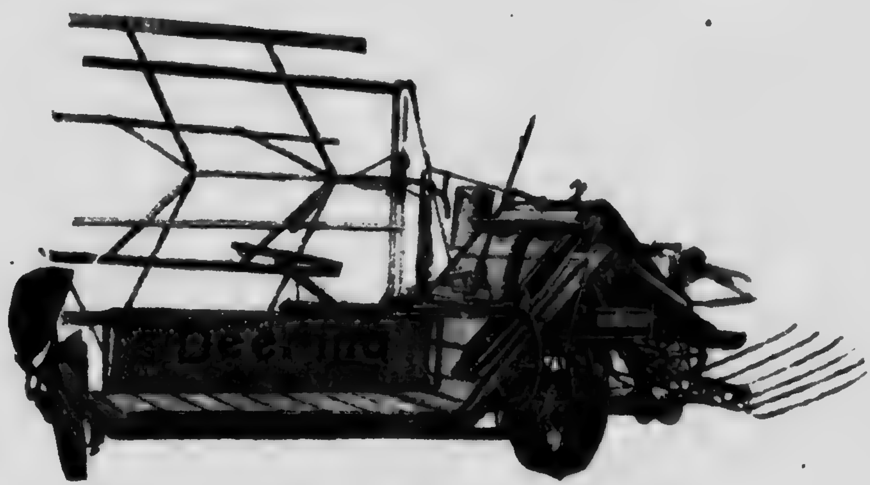

Fig. 10

Modern Side Cut Self-Binder, fully equipped with up-to-date auxiliaries.

Adjustment of Guards and Sickle.—One of the first things to observe, when getting a binder into shape for harvest, is to see that the guards on the sickle bar are in line. First, see if all guard bolts are tight; next, sight along the points of the guards, and if any are out of line, bring them into line by tapping with a hammer. Examine the ledger plates in each guard, and if there are any with deep nicks, such as may result from an encounter with fence wire, replace them with new ones. Sickle sections that are nicked or broken should also be removed and new ones substituted. Be sure that the clips

which hold the sickle in place are firm, so that the sickle and ledger plates work with a true, shear cut.

Next, determine if the sickle registers—that is, if during a stroke of the pitman, a sickle section moves from the centre of a guard to the centre of the next. If it does not, the lost motion in the pitman and connections must be taken up so that it does. If this cannot be done effectively, buy a new pitman—it is usually made of wood, and costs but little.

Chains and Crown Wheels.—In order that a binder may run with the least possible wear and friction, the crown wheels carrying the main drive chain, as well as those carrying the elevator chain, must be in perfect line. This can be easily determined by sighting along the face of the wheels, and, if any are out of alignment, they can often be put back by taking up the end-play of the shafts by means of washers. The chains should be run just tight enough to stay on the wheels—for tight chains unnecessarily increase wear, friction and draft.

Bevel Gears and Counter-Shaft.—Considerable trouble is often experienced by the main, or bevel,

Fig. 20
Device found on all Binders for taking up the End Thrust on the Counter Shaft.

gears, not meshing properly; and, if allowed to run that way, they will soon wear out. A device similar to that shown in Figure 20 is found on all binders, for the purpos taking up the end thrust on the counter-shaft. In making the adjustment, half the play should be taken up with this device, and the rest by putting washers on the pitman shaft. If all the play is taken up on the counter-shaft, the gears will not mesh properly, and will consequently wear out faster. In case one of the gears must be renewed, the other should also be replaced, as old and new gears will not mesh well.

The Reel.—The adjustment of the reel has a great deal to do with the condition of the bundles. It should be so placed as to strike the grain near the top, straightening it up for the sickle and bending it back over the platform without throwing it rearward, as the reel will if placed too low. In uneven grain, especially if it contains spots that are lodged or tangled, the reel requires constant attention if good work is to be expected.

To adjust the reel slats, lower the reel and place the slats so that they pass close to the inner grain shield.

On account of its weight, the reel sometimes sags to such an extent that if it is run close to the platform the outer ends of the slats may strike. Nearly all binders are now provided with a guy rod attached to the reel post, which may be lengthened or shortened so as to make the reel parallel with the platform.

The reel on most binders is so placed that the inner ends of the slats travel slightly in advance of the outer ends, thus forming an angle between the slats and sickle. The reel is placed in this position

for the purpose of counteracting the tendency of grain to go head-first into the elevator. Although this is, strictly speaking, not an adjustment, this angle may be increased, if need be, by bending or otherwise shortening the brace rod usually extending from either the U-tube or elevator frame to the reel post.

Elevators and Canvases.—The objection to the open elevator binder has been that the upper elevator frame was not rigid enough to permit the canvas to run true. This objection has of late years been largely overcome by most manufacturers, who have given special attention to bracing and strengthening this part of their binder. Nevertheless, it often happens that the lower as well as the upper elevator frames get twisted, or, as is often the case, have not been properly squared when first erected. If the elevator frame is not square, the canvases run hard, the slats break and come loose from the canvas, the bearings wear out, and the draft is greatly increased.

To square the elevator, measure with two sticks or laths, diagonally across from the lower roller to the upper, and, if square, the two diagonals are equal. If they are not equal, lengthen or shorten the brace rods provided for that purpose until these measurements are the same. A carpenter's square may be used for squaring the elevators, by placing one arm of the square along the face of the roller and the other along the elevator frame. This method is accurate only when the roller is straight. If it is sprung, as is often the case on old binders, the first method should be used.

The canvases should be run only tight enough to prevent slipping, and they should be slackened when

the binder is not in use. Some binders are provided with handy devices for slackening the canvases without unbuckling the straps. These devices, in their best form, are to be recommended, and should be found on every binder.

Miscellaneous Adjustments.—A binder will do best work when tilted slightly forward, as that will serve to keep the butts of the grain well towards the front of the elevator and against the butter, thus insuring even-butted bundles.

The lever for shifting the binder so as to place the band on the middle of the bundle should have a range of at least 15 inches. This shifting device should be kept working easily, and the operator should keep the binder attachment in such a position that it is not necessary to move the butter very much to equalize the bundle. If the butter is run at a considerable angle the deck not only chokes up easily but the draft is greater, more grain is shelled out, and the bundles will not be square.

The grain cover over the deck is made adjustable and may be raised or lowered so as to provide more or less space on the deck as required. When heavy grain is cut it may be desirable to raise the grain cover. When cutting ripe oats, for example, which is often so light and fluffy that it piles up so the packers cannot reach it, lower the cover so as to force the oats down to the packers.

The Binder Attachment contains the vital parts of the binder, and on account of its somewhat complex mechanism is more likely to get out of order than any other part of the binder. One of the first things to learn about the binder attachment is that its mechanism must be accurately timed so that all

its parts act at the right instant. The failure of the operator to realize this is a fruitful source of trouble. The manufacturers, in order to facilitate the taking apart and putting together of the mechanism, ordinarily make use of time marks. These time marks are usually small projections cast on a pair of opposite cogs in wheels meshing together. If it becomes necessary to take the attachment apart and no marks can be found, trouble may often be avoided by first making time marks with a cold chisel.

A typical binder attachment with its parts numbered as follows is shown in Figure 21:—1, cam wheel; 2, tyer wheel; 3, knotter; 4, harp brace; 5, breast-plate; 6, discharge arms; 7, bundle stripper;

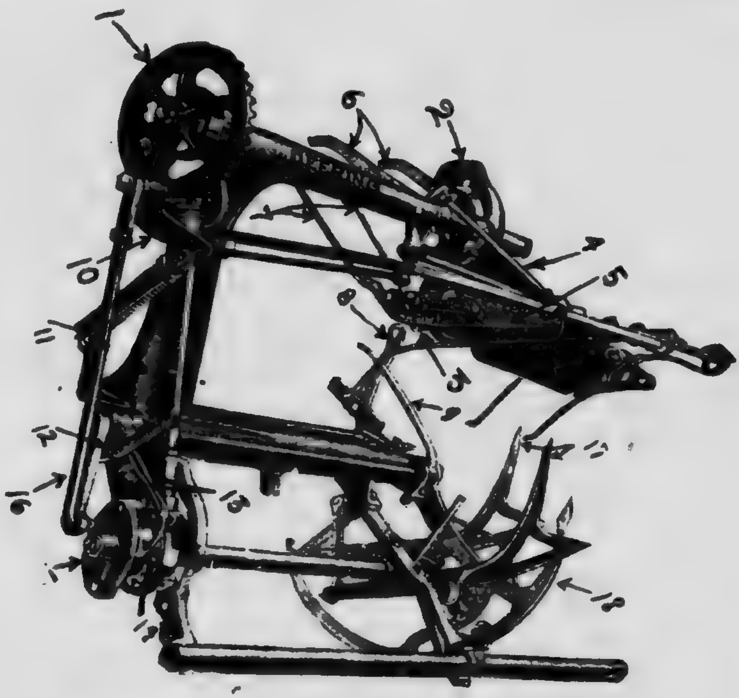

Fig. 21
Binder Attachment with parts numbered.

8, compress finger; 9, trip flap; 10, compress lever; 11, compress spring; 12, bundle sizer spring; 13, trip stop; 14, trip latch; 15, double drivers; 16, needle pitman; 17, packers; 18, needle.

A popular type of knotter is shown in Figure 22. The most essential parts are:—1, knotter frame; 2, knotter pinion; 3, knotter bill; 4, knife arm; 5, disc; 6, disc gear; 7, disc worm; 8, disc pinion; 9, cord holder spring; 10, knotter spring.

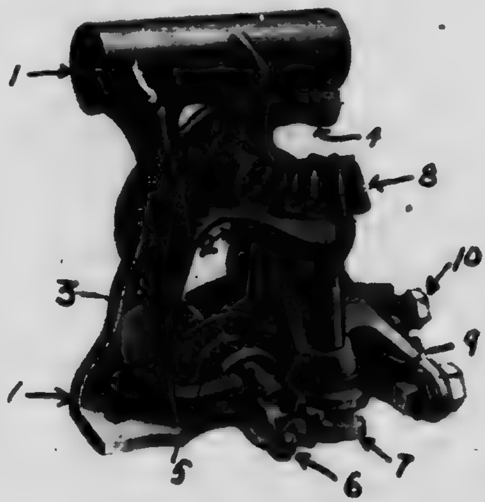

Fig. 22
Popular Type of Knotter.

The Knotter Bill.—Perfect smoothness, so that the twine may be readily stripped off is a prime requisite for the good working of the knotter bill. When the binder was last stored away, the knotter bill should have been oiled to prevent rusting. All rust should be removed from the bill with emery cloth or fine sand paper, and care should be taken so as not to bruise or mar its surface.

The Knotter Pinion.—This must fit close to the face of the tyer wheel so as to hold the knotter bill

rigidly in position. The slide of the knotter pinion often wears to such an extent that the pinion rocks against the face of the tyer wheel. A rocking knotter pinion may be detected by jerking the knotter bill up and down with the hand and, if it moves to any extent, the lost motion should be taken up or the pinion renewed. On some binders there is sufficient space between the hub of the tyer wheel and the knotter frame so that the former can be driven in on the shaft and the play taken up in this manner. Care should be taken not to drive the tyer wheel up so tight as to cause unnecessary wear and friction.

Knife Arm, Cord Stripper and Upper Cord Holder.—Most machines use the swinging knife arm as shown in Figure 22. In addition to carrying the knife, this type of knife arm by means of a deep notch holds the cord while the knot is being formed after which it strips it off the knotter bill. When the knot is being made, this notch must hold the cord rigidly in place or the knotter may lose one or both cords. In order to hold the knife arm rigid the breast of the needle drops into the notch and should fit closely enough so that the knife arm cannot be moved in either direction. If the knife arm is held loosely, the needle may be thrown forward a trifle, but care should be taken not to throw it so far forward that it will bend the knife arm. If it is not desirable to move the needle the knife arm may be raised by putting a washer on the knife arm pin. Sometimes one of the cords fails to drop into the notch on the knife arm. If it does the knotter will fail to secure it and a knot is formed only on one end of the cord. This may be caused by lost motion of the knife arm which permits it to move out of place.

A Different Type.—In Figure 23 is shown a knotter with a different type of knife and cord holder. The parts as numbered are: 1, knotter bill; 2, disc; 3, knife; 4, cord holder; 5, upper cord holder; 6, needle. In this binder the cord is held over the knotter by means of the odd shaped casting 5 and as the knotter revolves in making the knot it lifts the cord from this holder and allows it to slide down into the notch in the breast plate below 5 after which the knot is stripped of the bill by the discharge arms.

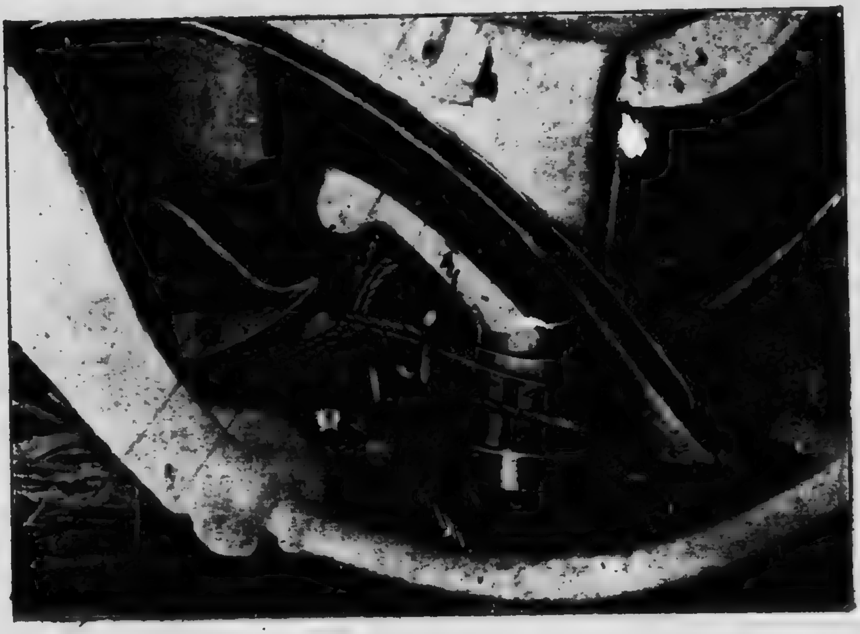

Fig. 23
Another Type of Knotter with different Knife and Cord Holder.

In order that the knot may strip off easily, the knotter bill, when at rest, is at an oblique angle with the cord, while the knotter bill in Fig. 22 is at right angles with the cord. This position of the bill, together with the fact that it must transfer the cord from the upper cord holder, makes the binder shown

in Fig. 23 apt to throw loose bundles if the knotter pinion rocks. For this reason, a rigid knotter pinion is especially essential with this type of binder.

The Knife.—The knife must, during a season, cut several thousand twines and like any other edged tool, it becomes dull and needs an occasional re-sharpening. A small whetstone or milled file should be kept in the tool box for that purpose. A dull knife is often responsible for loose bundles where the cord has been broken. It also entails an unnecessary strain on the knotter bill and other parts.

The knife must be accurately timed for if the cord is cut too soon, the knot will come apart, and if cut too late the twine may be broken by the discharge arms. When the knife is too late the twine is usually broken on the opposite side of the bundle and the knot remains on the bill.

To determine if the knife cuts the cord at the right time, turn the binder carefully by hand and the instant the knotter tongue closes down on the cord the knife should be snug up against the cord and, with further motion, should cut it immediately. If at this time the edge of the knife is not up against the cord the knife is late and if the cord is cut the knife is too early. The knife arm, which is made of malleable iron and will stand bending, can be adjusted by bending with a monkey wrench in the direction that will secure the desired effect. Before this is done be sure that the knife is out of time and, if it is, bend it but slightly as it takes very little to produce the desired effect.

The revolving knives shown in Fig. 23 seldom get out of adjustment and then only through lost motion in the disc pinion or by the wearing back of the

edges of the knives. Some binders have a stationary knife that cuts the cords as they are stretched over its edge when the bundle is discharged.

Fig. 24 shows the proper relative positions of the knotter and knife arm when the cord is being cut.

Fig. 24.

Showing relative positions of Knotter and Knife Arm when the Cord is being cut.

The Knotter Spring.—Should be just tight enough to cause the knotter to open and close sharply and to hold the cords tight enough to form a good knot. If the knotter spring is too tight the knotter bill will not let go of the knot readily when it is formed, and the cord will break and remain

hanging on the bill. This is especially true when weak places are encountered in the cord. If the spring is too loose the knotter will let go of the cord before the knot is completed and loose bundles result. This is certain to happen when a thin place on the cord comes in the knotter.

If the spring is partially loose and the knife is dull, the knife will shove the knot out of the bill so that one cord may be lost while a knot is formed on the other. In less pronounced cases, bow or slip-noose knots which often fail when the bundle is handled, are formed.

In binders that are old or have been run with the knotter spring too tight, the cam on the knotter frame on which the knotter tongue roller rolls sometimes becomes excessively worn. In that case the knotter tongue opens up insufficiently to readily catch the cords. Sometimes only one is caught when a loose bundle accompanied by a cord with a knot on one end is discharged from the binder. To repair this difficulty, a new knotter frame is usually necessary, but this expense may be obviated by making a larger knotter tongue roller. An ordinary roller may sometimes be made to serve by flattening it on the anvil.

The knotter spring is usually quite stiff and a slight loosening or tightening makes a great difference in its tension. In adjustng this spring never tighten or loosen it more than a quarter of a turn at the time.

Disc, Cord Holder and Cord Holder Spring.—The disc shown in Fig. 22 is a flat wheel or disc with notches for catching and pulling the cord into the cord holder. This disc has six notches, and as it travels only the distance between two notches for

each bundle, the wear is slight, and in binders properly adjusted and oiled it seldom gives trouble. In old binders, or where the wear has been excessive, due to a too tight cord holder spring, enough lost motion in the disc pinion and in the disc gear and worm may develop to cause the disc to lag too far behind. The cord is then caught on the shoulder of the notch which bruises the cord and often causes it to break under the strain of tying and compressing.

The difficulty may often be adjusted by taking off the disc gear and placing it back on its pin, the other side to, which throws the wear on the other side of the cogs. If the wear is excessive the worm, at least, should be renewed.

In some binders the disc is driven by an arm, similar to the knife arm which operates a dog working in a ratchet on the back of the disc. The disc dog is adjustable and the travel of the disc may be changed.

In Fig. 23 is shown a wheel-shaped disc with grooves across its face for holding the cord in the cord holder and notches in the upper side of its flanged rim for carrying the cord into the holder. The twine sometimes wears grooves in this disc and its cord holder so that the cord slips out. These parts must then be renewed.

Every binder has an upper and a lower cord holder between which the two cords are stretched and held so that they can be grasped by the knotter. The tension of the lower cord holder is regulated by the cord holder spring which is the most important spring on the entire binder. The tension of this spring must be tight enough so that the cord will not be pulled out of the disc and yet it must be loose

enough to allow the cord to slip a trifle as the knot is formed. The reason for this is that the knotter grasps the cord so tightly that it cannot slip on the knotter bill, and consequently, part of the cord needed for making the knot must be secured by the cord slipping in the disc. If the cord holder spring is so tight that it does not permit the slippage of the cord in the disc, the cord is broken at the disc while the knot is being formed and a knot on only the other end of the cord is the result. If the cord holder spring is too loose the cord is pulled out of the disc when the bundle is being packed on the twine. The result is that a loose bundle together with a piece of cord having a knot on one end is discharged from the binder, but the disc usually retains the twine.

The proper tension of the cord holder spring may be determined by exerting a steady pull on the cord. It requires a strong pull to break an average cord, and it should pull out of the disc instead of breaking. As the cord is pulled out the cord holder should snap against the disc with a click indicating that the spring is active. In adjusting this spring tighten or loosen it only a little at a time and observe results.

In some machines the knotter bill is set eccentric on its pin so that it has a slight movement towards the disc while revolving to form the knot. In another machine the disc moves towards the knotter when the knot is tied.

The Needle and Pitman.—The needle should go far enough forward to deposit the cord securely in the notch in the disc. If it does not go far enough forward to do this, the cord will be wrapped around the upper part of the knotter bill. To throw the

needle farther forward, shorten the needle pitman and lengthen it to throw the needle farther back. After changing the travel of the needle turn the binder over by hand before driving to make sure it does not strike. This precaution is important for it is possible to throw the needle so far forward as to bend the knife arm and needle or break the binder arm.

Sometimes the needle is thrown out of adjustment by becoming bent. To ascertain this, examine the needle to see if it deposits the cord properly in the disc. If it does not and still travels as far forward as possible the eye of the needle has been bent up. The needle is usually made of a good grade of malleable iron and may be bent back into shape with little risk of breaking. To do this, grasp the tail of the needle with the left hand and pull up so as to take up the jar and hit the needle on the top, back of the head in order to bend it down. To bend it up strike on the under side. It should not be necessary to add that this adjustment should not be made until one is thoroughly satisfied that the needle has been bent.

The Cam Wheel.—Derives its name from the cam or slide which it carries. This cam operates the compress lever so as to compress the bundle while the knot is being tied. The surface of the cam should not be oiled as that causes the roller to slide. If the roller is permitted to slide it will soon wear flat to such an extent that it will fail to give the proper motion to the compress lever and the result is poor compression.

Compress Finger and Spring.—The compress lever controls the compress finger so that the bundle is compressed between it and the needle. The compress spring is interposed between the compress lever

and finger to give elasticity to the mechanism during compression. If it were not for the compress spring there would be danger of breaking or clogging the binder during compression. The compress spring must not, therefore, be so tight as to give a dead compress. To determine if compression is right, turn the binder over until it is at the greatest point of compression and if by a steady pull with one hand you can pull the compress finger backwards the compression is about right. This test is based on the fact that the compress spring should never be so tight that the compress finger cannot back away from the needle during compression if necessary.

The Bundle Sizer Spring.—This spring regulates the size and tightness of the bundles. To make larger bundles, increase the tension on the spring, and decrease it to make smaller bundles. The bundle

Fig. 25
Roller Tension used for preventing Binder from being ruined by continually keeping tension too tight.

sizer spring acts by increasing or decreasing the weight necessary to trip the binder and, consequently, the compress finger should be moved down so as to give more space for larger bundles and moved up to give less space for smaller bundles.

The tightness of the bundles should be regulated by the bundle sizer spring instead of by the twine tension. The twine tension is merely for taking the slack out of the twine and should not be any tighter than is necessary to accomplish this. If the twine tension is too tight the twine will wear grooves in the needle, disc and other parts. Fig. 25 illustrates a roller tension which is excellent for preventing the binder from being ruined by habitually keeping the tension too tight. This tension can hardly be screwed down so tight but that it will roll readily with a moderate pull on the twine.

The Trip Stop, Trip Latch and Trip Spring.—Most binders are tripped by pressure on the compress finger, but the one illustrated in Fig. 22 is tripped by a trip flap as shown in the figure. The trip flap or compress finger, as the case may be, raises the trip stop and the binder is thrown into gear by the trip spring forcing the latch forward so that it is caught by the double drivers. The trip stop throws the mechanism out of gear by lifting the latch so that it escapes the double drivers.

Farmers sometimes come to town complaining that "the arms won't go round." This is due to either a broken or weak trip spring or to the shoulder on the trip latch being worn so that it slips off the double drivers. This difficulty is easily detected and as easily repaired.

Header Binder.—The header binder shown in Fig. 26 is the latest important addition to harvesting machinery. For all practical purposes it is a dual type machine; by removing the binder attachment and putting on an elevator it may be used as a header when conditions are favorable. This machine

is usually made with a 12-foot plaform, which gives it the capacity of two ordinary binders and saves the labor of one man.

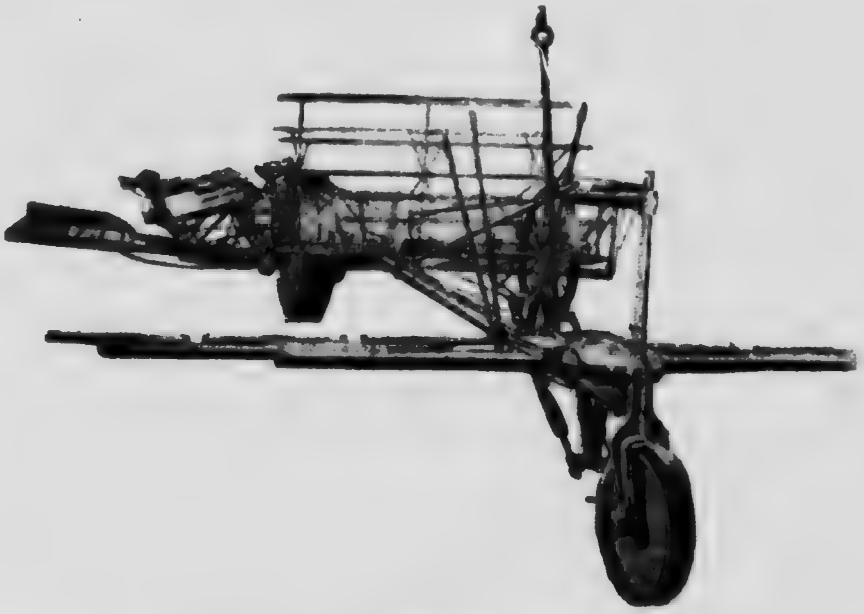

Fig. 26
Head Binder, latest important addition to Harvesting Machinery.

Mechanical Power.—Mechanical power for harvesting is being used in many localities where steam or gas tractors are used for plowing. During recent years experiments have been made by manufacturers and farmers with a small general purpose gasoline engine attached to the binder as shown in Fig. 27. The engine is intended to merely operate the mechanism of the binder while it is being hauled by horses. Two horses will furnish ample power for hauling the binder and when t engine is not used for harvesting it may be detached and used for pumping water, grinding feed, etc,, so that it will be found a very economical source of power. This

method of harvesting will doubtless prove popular on small and medium sized farms where tractors cannot be used economically.

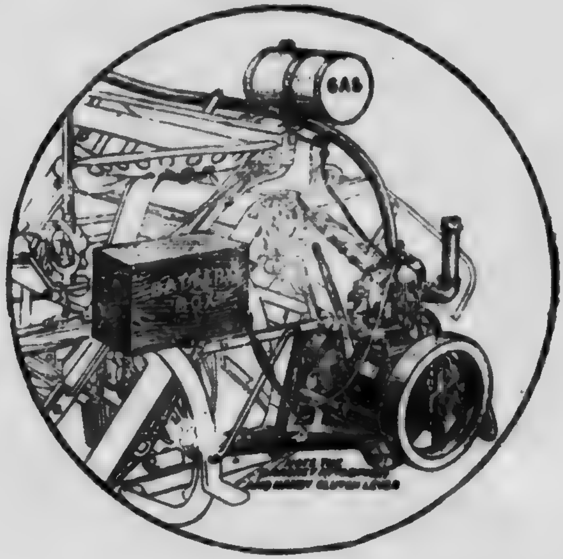

Fig. 27

Small Gasoline Engine used to operate mechanism of Binder while it is being hauled by Horses.

CHAPTER III.

THRESHING MACHINERY

Although it is true that the modern thresher with its enormous capacity of over two thousand bushels per day has been perfected within the memory of men living to-day, it is nevertheless true that its primitive conception dates back to the dim and distant past of prehistoric times. Like most great inventions the threshing machine in its perfected state is not to be credited to the efforts of one or two men, nor to the mechanical skill of one country alone, but to the inventive genius of both Europe and America as well.

The modern machine is a consolidation of what was at an early period in its development three separate machines. It consists essentially of a threshing machine, a separating machine and a cleaning machine or fanning mill. Since the grain is acted upon by the threshing devices first and in turn passes through the separating and cleaning mechanisms this order will be followed after which will be discussed such auziliary devices as the self-feeder, blower, etc., that, while being important labor saving devices, are not essential to the efficient operation of the machine itself.

The Threshing Devices consist of the cylinder and concaves.

The Separating Devices may be classified into primary and auxiliary. The primary separating devices consist of either racks or raddles while grates, beaters, pickers, spreading forks, etc., which are found in many machines to aid separation, are commonly called auxiliaries.

The Cleaning Mechanism **consists of a fanning mill sometimes seconded by another mill called a re-cleaner usually placed on top of the machine.**

The Cylinder.—The object of the cylinder is to loosen the grain from the straw. This it does by striking the straw with its rapidly revolving teeth which pass between similar teeth in the concave. The common type of cylinder shown in Fig. 28 is

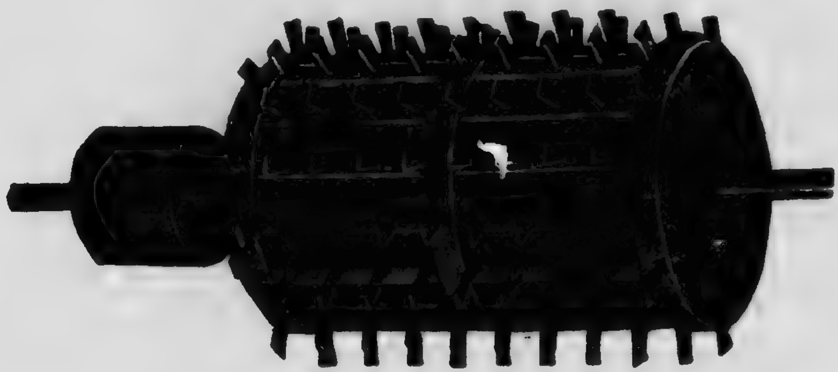

Fig. 28
Common Type of Cylinder used in Threshing Machines.

constructed by attaching parallel bars to the circumference of cast spiders or wheels mounted on the cylinder shaft. The bars carry the teeth, as shown, and to make the cylinder rigid enough to withstand the great centrifugal force generated by its high speed and the enormous strain of threshing, heavy wrought iron bands are shrunk on over the bars. A solid or drum cylinder is used by some manufacturers but the bar cylinder is by far the most common. The teeth are usually held in place by nuts and lock washers although tapered wedges as shown in Fig. 29 are employed by some manufacturers. The bars are usually made double when the cylinder is

known as a double bar cylinder. The double bar is used because it will yield slightly, thus reducing the tendency of teeth to break off at the shank. Wooden

Fig 29

Teeth used in Cylinder are held in place by Nuts and Lock Washers as well as Wedges.

bars reinforced with steel plates and rivets are employed for this purpose with good results by some manufacturers.

Length of Cylinder is an important factor in determining the size of the machine. Separators are designated by size as 36x60 or 40x66, etc., the first number referring to the length of the cylinder and the second to the size of the separating racks.

Size of Cylinders varies greatly in modern machines and is determined by the number of bars rather than by the diameter. A 12-bar cylinder is spoken of as a standard cylinder, and is the smallest used on modern machines. The sizes range from 12 to 21 and 22 bars.

Opinions differ as to the relative merits of the large and the small cylinder. Both will do good work and as far as can be observed both require

about the same amount of power. It is urged by builders of the large cylinder that its greater momentum will cause steadier motion and less liability to "slugging." They also claim that since a larger cylinder pulley can be used there is less belt slippage and it also enables them to use a larger grate surface, thus securing better separation. The builders of small cylinder machines contend that as the speed of the large cylinder is less its momentum is no greater than that of the small cylinder; besides, its larger radius gives greater leverage for any material in the concave which may produce "slugging." They maintain, further, that with proper construction a sufficiently large grate may be secured with a small cylinder and that the large cylinder, weighing often about a ton, throws an unnecessary weight and strain on the framework and other parts of the machine.

Cylinder Speed.—This is usually given in revolutions per minute, being about 1125 for the standard 12-bar cylinder and in the neighborhood of 800 for the 20-bar cylinder. The true threshing speed is the speed with which the cylinder teeth travel through the concave and is about 6000 feet per minute which has been found to secure the best results when the gra[illegible]n good condition for threshing. Manufac[illegible] base the number of revolutions per minute tha[illegible]ir cylinder is to run upon its diameter so that the threshing speed is about the same, 6,000 feet, regardless of its size. Proper threshing speed is important if good results are expected, and every threshing machine operator should have a reliable speed indicator so that he may be assured that his machine is running at the proper speed.

Cylinder Bearings in order to withstand the tremendous strains of threshing, must be of ample size and of good construction. The cylinder boxes should be self-aligning so that there will be no binding even though the frame may sag or twist. The bearings are usually either of brass or babbit. Brass bearings when in good condition will run with slightly less heat and friction than babbit, but are much more expensive to replace when worn out, and for that reason are not so popular. A competent separator man should be able to line up the shaft and pour new babbit bearings when necessary.

Proper Adjustment of cylinder boxes is important, and if neglected they will soon heat and cause trouble. Before starting a new machine the caps should be removed and dirt or grit which may have lodged in them during shipment of the machine from the factory should be carefully removed. If a box pounds or heats the lost motion should be taken up a little at a time and care should be used not to get it too tight.

Lubrication of cylinder boxes is secured by either hard or liquid oil. Hard oil is convenient because it can be used in compression cups, but does not lubricate a high speed bearing like those of the cylinder as well as does a good grade of liquid oil. The best type of oiler at present on the market for cylinder boxes is the ring or chain oiler. It consists of a ring or chain having a slightly greater diameter than the cylinder shaft which revolves in a groove in the bearing and dips into an oil reservoir in the lower half of the box, thus continually carrying oil to the top of the bearing.

The Concave.—The concave derives its name from its shape, being concave so as to fit the periphery of the cylinder. As shown in Fig. 30 it consists of two slides, one on each side of the machine, which hold the concave bars that carry rows of teeth similar to those of the cylinder.

The office of the concave is to act as a holder or retarder, while the cylinder teeth thresh the grain out of the straw. While it is necessary that the kernels be effectively jarred loose from the straw, it

Fig. 30

The Concave consists of two Slides, one on each side of the Machine, which hold the Concave Bars that carry rows of Teeth, similar to those of the Cylinder.

is desirable to get the straw through the threshing devices as unbroken as possible. Broken straw not only means a great waste of power, but drops through the racks and gets into the fanning mill where it clogs the sieves and causes waste of grain.

The proper adjustment of the concave is, therefore, of great importance if efficient threshing is to

be done. As is clearly shown in Fig. 30 the position of the concave with respect to the cylinder is made adjustable. Concaves may be adjusted so as to be concentric with the cylinder or so that there is a larger opening between the cylinder and the concave in the rear of the concave than at the front, or vice-versa, as desired. It is usually safest to place the concave lower at the rear than in front because this permits any material that gets into the cylinder to get out and tends to lessen the danger of clogging and breaking of concaves.

Number of Teeth to Use.—The number of teeth to use with different kinds and conditions of grain is also of great importance. Each concave bar usually carries two rows of teeth although some large machines have three row bars. Six rows of teeth or three bars fill the ordinary concave, and when fewer teeth are needed blank bars or grates are used to fill the circle. In Fig. 30 four rows are shown, two in front and two in the rear with a grate bar in the middle. It is good practice to always use as few teeth as possible and to run the concave rather close instead of using a large number of teeth with the concave open.

FOR WHEAT AND BARLEY, when in average good condition for threshing, use four rows, two in front and two behind, although three rows will often suffice. When the grain is damp, five rows may be necessary.

FOR RYE, two rows, both in front, or better, one in front and one behind, will be ample, but the speed of the machine should be increased to prevent winding.

FOR OATS, two rows placed the same as for rye will be sufficient, and when damp use three or more.

FLAX AND TURKEY RED WHEAT require six rows. Some machines are provided with special bars having corrugated teeth for these crops, and for clover and other grass seeds.

It is a good rule never to use a blank in the front of the concave as this gives the cylinder too much draft and may cause clogging and breaking of the concave.

Grates.—Back of the cylinder and extending from the concaves upward and backward are the grates which play a very important part in separation. The grates are generally made from thin, flat bars of wrought iron placed in a frame at such an angle as to deflect the grain thrown against them through to the grain pan below. Although nearly all grates on the market consist essentially of a slotted wrought iron construction, they are made in a variety of shapes and sizes, depending upon the ideas of the inventor and the pickers and beaters used in connection with them. The machine shown in Fig. 32 has a very large grate over which the straw is combed by means of two crank mounted forks as shown. The machine shown in Fig. 33 has a grate which is given a rocking motion by means of eccentrics.

Beaters.—The cylinder whose teeth travel at a speed considerably above a mile a minute necessarily imparts an enormous velocity to the straw and grain which, if not retarded in some manner, would be thrown to the rear of the machine. This difficulty is overcome in most machines by placing immediately behind the cylinder a fan-like drum called a beater (see Fig. 31) which intercepts the straw and flying kernels, retarding their motion and allowing them to pass on to the straw racks at a much lower rate of speed. Besides stopping the flying grain the beater

assists in separating; prevents clogging and winding of the cylinder by removing straw, which would otherwise pile up in the rear of the cylinder; spreads the straw in an even sheet above the racks and is also said to create a suction which draws disagreeable dust through the machine away from the operators. It is generally conceded that the beater has but little

Fig. 31

Beaters, used for intercepting Straw and flying Kernels and allowing them to pass on to Straw Racks at a much lower rate of speed.

value as a separating device for its rapid motion gives it a tendency to throw the grain it beats out of the straw up and rearward, where it falls on top of the straw to be lost or re-separated by the straw racks. The beater has been found to perform its work best when revolving just rapidly enough to prevent winding.

Check Boards.—Behind the beater or spreader is usually placed a fall-board or curtain, commonly known as the check board, for the purpose of checking the straw and flying kernels as they come from the cylinder. The check board also serves the additional purpose of compressing the straw, which leaves the cylinder and beater in a loose, fluffy condition not favorable to the most efficient action of the separating racks and raddles. Check boards are usually made adjustable so that the amount they retard and compress the straw may be varied to suit existing conditions.

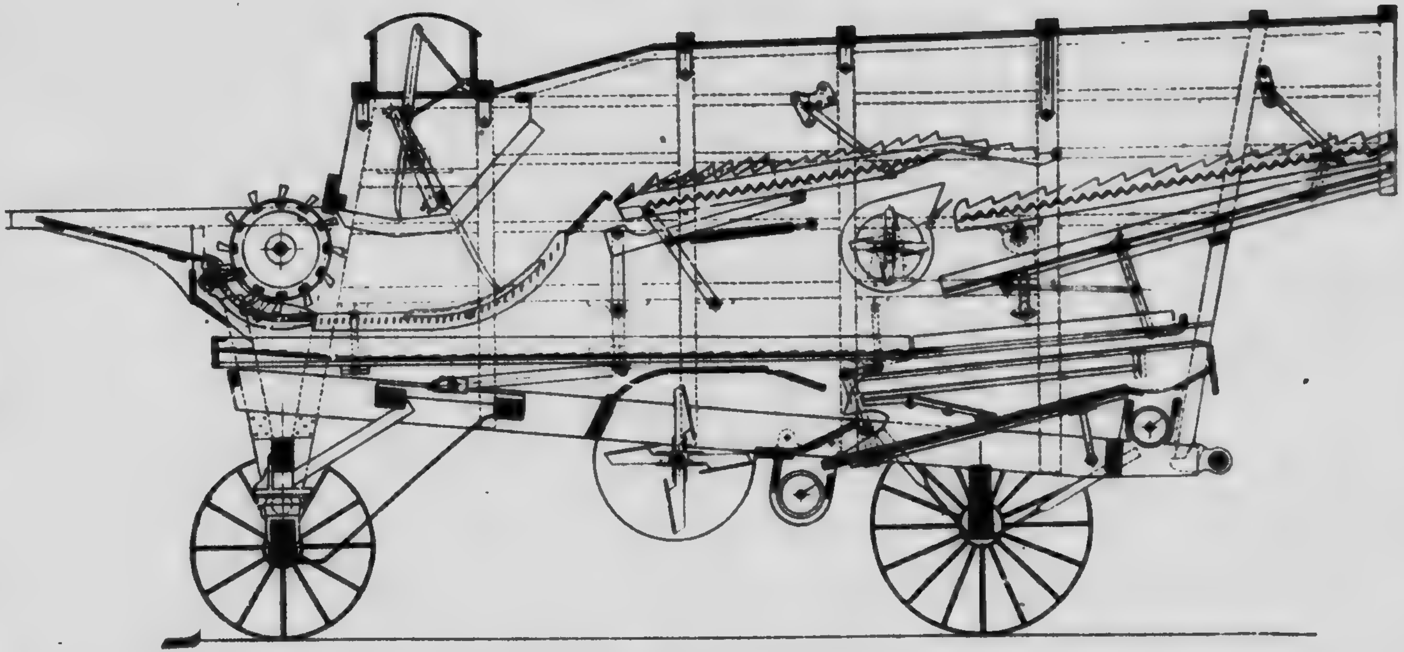

Fig. 32

Diagramatic Drawing of Thresher showing Straw Rack constructed entirely of Wooden Slats, containing sufficient openings to allow grain to fall through, while the straw remains above.

The Straw Rack.—This is generally constructed entirely of wooden slat work, containing sufficient openings to allow the grain to fall through, while the straw remains above. Notched boards or fish backs as shown in Figs. 32 and 33 are often placed on top of the racks to aid in agitating the straw and to facilitate its rapid motion rearward. Besides having openings of correct amount and size, another essential feature of straw racks is lightness consistent with strength and durability.

Rack Balance.—A rack machine generally contains two or more separating tables or racks, and it is absolutely necessary to the smooth running and good lasting qualities of the machine that they be perfectly balanced. To accomplish this their vibrations alternate, that is—the two racks always move in opposite directions. This arrangement not only serves to give the machine a regular steady motion, but also prevents "bunching," as a bunch of straw, even if it happened to pass the front racks and pickers, could not pass the junction of the racks without being pulled apart.

Rack Motions.—Although there are numerous combinations and modifications, rack motions may be classified into three distinct types—the concave, convex and rotary motions. The former is produced by suspending the rack by means of hangers and oscillating the rack by cranks which give a concave motion to the rack surface. The convex motion is produced by mounting the racks on rocker arms, while the rotary motion is produced by attaching the racks directly to a series of revolving cranks which impart a circular motion to the rack. These motions are used with good results in various combinations. In the machine shown in Fig. 32, for example, the front rack is mounted on a rocker arm and a hanger,

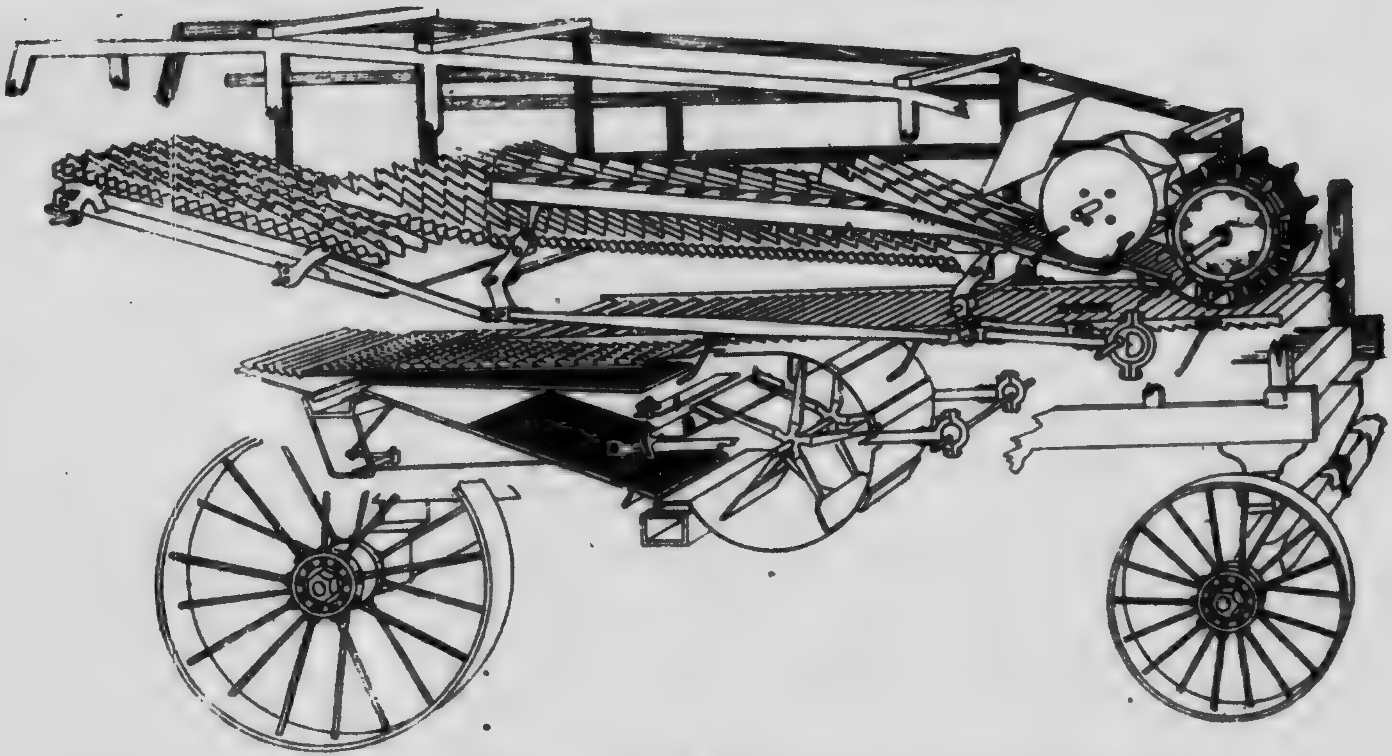

Fig. 33

Diagramatic Drawing of Threshing Machine showing how the Rack motions are secured.

while the rear rack is given a circular crank motion at its front end and a concave hanger motion at its rear. It is plain that a combination of these motions imparts to every section of the rack a slightly different motion from that imparted to every other section which cannot help but agitate or stir the moving column of straw in such a way as to loosen the kernels of grain and permit them to drop through to the grain pan below.

The Grain Pan.—Beneath the separating devices and extending well underneath the grates and concave, is the grain pan. As shown in Figs. 32 and 33. it forms the floor of the machine and receives the grain and chaff as it falls through the separating devices. In a rack machine it generally receives its motion from the same mechanism as do the racks and is so oscillated as to counterbalance them. Being merely a vibrating platform designed to convey the uncleaned grain to the mill it is very simple in construction and is plainly shown in the illustrations referred to.

The Auxiliary Blast Fan.—This is a comparatively recent innovation in the line of separating devices. It is simple in construction, and consists of a rapidly revolving encased fan, similar to that of the fanning mill, whose blast is directed against the straw and chaff on the racks. The blast has a tendency to lift and dislodge the straw, allowing the grain to separate freely. It also blows a great deal of chaff to the rear of the machine where it passes into the straw instead of encumbering the fanning mill and tailings conveyor. Fig. 32 shows the fan placed immediately below the front rack with its blast directed to strike the straw as it falls on the second rack. This arrangement very effectively exposes the straw to the action of the blast.

The Shoe or Fanning Mill.—The function of the shoe is to properly clean the grain as fast as delivered to it by the separating devices and, unless the shoe can do this well the machine is not a success no matter how perfect are its threshing and separating devices.

The Combination Blast and Sieve Shoe.—This is the most common type, and may be said to embody three essential parts or principles, viz., the sieves, the blast, and the motion. This type of shoe is employed in the machines illustrated by Figs. 32 and 33.

Rotary Fan.—The rotary fan, which is the device used on all machines to create the blast, is placed in an enclosed drum under the separating mechanism. There are two types of fan designated by the direction of their rotation. If the blast is delivered above the centre of the fan it is called an overblast fan and if the blast is delivered below the centre it is called an underblast fan. Although different makers claim superiority for both types there is but little difference in the results as deflectors and wind boards, if properly placed, give the desired direction of the blast in either case. The fans, shown in Figs. 32 and 33, are both of the overblast type.

Sieves.—The office of the sieves is primarily with the aid of the blast to perform the final separation of the chaff and rubbish that has passed through the rakes or riddles. To meet the different requirements of the various kinds and conditions of grain threshed a number of interchangeable sieves, each adapted for a particular kind of grain, is usually furnished with each machine. In order to further meet the demands imposed by the different conditions of grain all up-to-date shoes are made with the

position of the sieves adjustable so that by varying the angle of the sieves the speed of the travelling grain may be changed and the blast deflected through the meshes as conditions may require. In many machines the angle of the sieves can be adjusted while the machine is in operation. This is a very desirable feature, and is certain to result in closer adjustment and better work than if the machine has to be stopped, which is expensive and not liable to be done.

THE CHAFFER or top sieve is placed at the rear end of the grain pan and oscillated above the shoe. Its purpose is to rid the grain of broken straw and rubbish before it passes to the sieves below. A large part of the chaff is also dispensed with on the chaffer. Chaffers are variously constructed. Some are made of wooden slat work sufficiently open to insure the free descent of all grain, others are made of flat iron strips the angle and openings of which are often made adjustable; still others are of the lipped steel pattern similar to the chaffer used in the machine shown in Fig. 33.

Tail Piece or Chaffer Extension.—In order to save any grain which has not been threshed out by the cylinder or which by some chance has passed over the chaffer, the chaffer is usually provided with an extension as shown in Fig. 33. This extension, or tailpiece, consists of the tailings spout screen ending in a slatted surface. Over this everything not passed through the chaffer must travel before making its final exit from the machine. This arrangement acts as a safety device and returns to the cylinder by way of the tailings elevator all grain that a too strong blast has thrown over the sieves or that the cylinder has failed to thresh.

The condition of the tailings are a good indication of how the machine is working. If the tailings contain much grain in the heads it indicates that too few concave teeth are used or that the concave is too open; if plump, threshed grain is found in the tailings it indicates clogged sieves, improper position of the sieves, or that the blast is either too strong or is concentrated too much through the rear end of the sieves. An efficient separator man will always observe the condition of the tailings and endeavor so to adjust his machine that they are as scant and free from grain as possible.

Motion—There are two types of sieve motions—the side shake and the end shake. The end shake motion causes a positive rearward movement of the material on the sieves, while in the side shake shoe this must be accomplished primarily by the blast. The side shake is used to spread the grain evenly over the sieves, but is not as commonly used as the end shake.

The motion should in all cases be strong enough to cause the grain to slightly leave the sieve at each oscillation thus moving the grain and chaff rearward with sufficient dispatch, and at the same time permitting the blast to readily blow the chaff out of the grain.

The shoe is often divided into two sections, each having a distinct separate motion. The upper section, containing the sieves, is then given a rearward and rising motion, while the lower section, which holds the screens and conveys the cleaned grain to the grain auger, has an inward and carrying movement. This method of constructing the shoe permits

of timing the motion of the two sections so that they will counterbalance each other.

The Blast.—In the shoe a great deal depends upon the uniform strength, direction and easy control of the blast. The blast should at all times be of just sufficient force to keep the meshes open and to blow the chaff rearward while the grain is being tossed upwards by the sieve vibrations.

It has been found essential that the blast be stronger under and in the sieve meshes than above. If this condition exists the strong blast in the meshes will keep them open while the milder blast above which, of course, must be sufficient to eliminate the chaff will permit any kernels that have been lifted to readily return. This condition can be produced only by making the open and solid portions of the sieves in proper proportion. This, according to several manufacturers, is about as five is to seven, so that the meshes will compose but 5/12 of the sieve surface, while the remaining 7/12 is blind, thus retarding 7/12 of the blast, making it only 5/12 as strong over the sieves as in the meshes. A wire sieve is too open to permit of this proportion, and hence is not as good as the different types of sheet metal sieves.

Windboards.—Windboards or blast deflectors are placed in the machine and made adjustable so that the main force of the blast may be directed to any part of the sieves. Some shoes are fitted with an upper and a lower windboard marked 1 and 2 respectively in Fig. 33. The former deflects a small portion of the blast in such a direction that it sweeps the surface of the sieves blowing the chaff rearward, while the lower deflector directs the major force of the blast up through the meshes of the sieves. The blast in coming up through the sieves should be

deflected as nearly perpendicular to the plane of the sieves as possible. This will permit of a strong blast which, if at an oblique angle, would blow grain over. A nearly vertical angle of the blast has also the additional advantage of allowing grain to descend more freely. The major portion of the underblast should be directed to the front, or fan end, of the sieves where it can at once commence a vigorous elimination of the chaff. If the main part of the blast is directed at this point, there is less danger of grain being blown over for, although the lighter grain may be unduly lifted it will return through the sieve when entering the milder blast zone in the rear of the shoe. If the blast is not of sufficient strength at the front end the meshes will clog at that point forcing the blast to escape through the rear portion of the sieves. This will cause chaff and dirt to fall through the fan end of the sieve, and is also certain to cause grain to be blown over the tail piece when entering the strong blast through the rear of the sieve.

The Strength of the Blast.—This is regulated by throttling the air through the intake in the fan case, and the device consists merely of movable blinds restricting the inrushing air at both ends of the fan drum. While some manufacturers make these blinds automatically governed by the wind pressure in the drum, their adjustment is commonly left to the discretion of the operator. In adjusting these blinds it must be remembered that the right blind effects the left side, and the left blind effects the right side. Therefore, if the grain is being blown over on one side the blind on the opposite side should be closed just sufficiently to prevent the grain from blowing over. A side wind will increase the pressure in that

end of the fan drum, consequently making it necessary to throttle the intake more on the windy side of the machine than on the other. As much blast should be used as possible without wasting the grain, and in this connection it is well to remember that the greater the amount of chaff and grain handled the stronger the blast required, for the blast will be spent and retarded in proportion to the density of the mass on the sieves. It consequently follows that a blast which is just right when the machine is taxed to its limit is apt to blow grain over when the machine is fed lightly.

Self Feeders.—The self feeder has won such universal favor and become such an indispensable adjunct to a machine, that it can scarcely be looked upon as an auxiliary device but rather as an essential part of the machine, necessary to its successful operation. In its best form it has to-day reached a state of perfection where, if properly cared for and operated, it will equal the most skilled hand feeder.

The difficulty with the proper working of a self feeder does not so much lie with the feeder itself as with the men who pitch the grain into it. If the pitchers would use the same care and judgment in their work with a self feeder as the hand feeder does when feeding the machine by hand, a self feeder would cause but little trouble. But, with the carelessness and ignorance so prevalent among the average workmen around a machine, the self feeder must literally furnish the intelligence that guides the forks in the loads or stacks. Cases have come under the observation of the writer where men have deliberately fed grown and matted bundles into the machine which they knew might choke the cylinder and, perhaps, result in an expensive breakdown.

With such difficulties to contend with, a self feeder, in order to be a practical and efficient substitute for hand feeding, must be simple, effective, durable and self governing. It must have a sufficient capacity to at least equal that of the separator, for if it feeds too slowly it wastes time, and if it feeds improperly it wastes grain. In order to properly fulfill these requirements it must be more than merely a set of band cutters and a raddle to carry the bundles. It must cut the bands without failing, distribute them evenly over the entire width of the cylinder, retard the lower part of the bundles and feed off the top in such a manner that the heads of the grain do not all strike the cylinder at the same time, but are evenly distributed throughout the straw and, above all, it must feed uniformly and at the proper angle as fast as the machine can efficiently handle the grain.

Fig. 34 illustrates a modern self feeder with crank mounted band cutters and an efficient straw and

Fig. 34

Modern Self Feeder with Crank Mounted Band Cutters and an efficient Straw and Speed Governor.

speed governor. Fig. 35 illustrates another feeder having revolving band cutters, fish back retarders, and a governing mechanism regulating the feeding by varying the speed of the feeding hooks in accordance with the amount of material in the feeder.

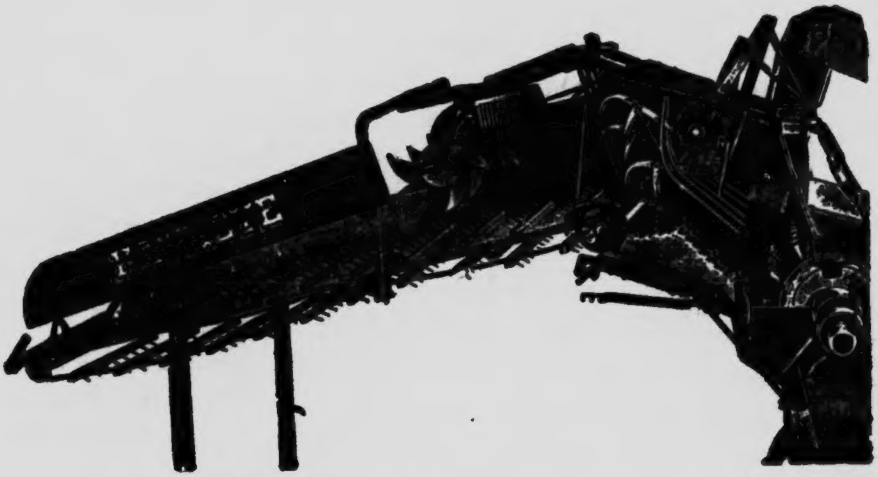

Fig. 35

Sectional view of Feeder with revolving Band Cutters, Fish Back Retarders, and mechanism for regulating Feed.

Miscellaneous Devices and Parts.—A modern machine is equipped with a large number of devices such as the pneumatic stacker, the grain elevator and weigher, etc., but these are simple in construction and will be easily understood. Much valuable information can be secured regarding them by referring to manufacturers' catalogues.

Manufacturers are always glad to furnish catalogues upon application, and the student will find them of material assistance in studying this lesson. It is also suggested that he thoroughly examine any and all makes of threshing machines which may be available

EXAMINATION QUESTIONS

1. What is the difference between a broadcast seeder and a drill?

2. For what conditions is a narrow track seeder or drill adapted?

3. What are the objections against a combination drill and disc harrow?

4. How is uniformity of depth secured with a shoe drill?

5. For what soil and field conditions is the double disc superior to the other types of furrow openers, and what are its advantages and disadvantages?

6. If it should become necessary to take the binder attachment apart what precautions should be taken to avoid trouble in putting it together again?

7. How can you determine if the knife cuts the cord at the right instant?

8. What is the trouble if the needle goes as far forward as possible and still does not come low enough to deposit the cord in the disc?

9. How would you adjust the binder to make larger bundles—tighter bundles?

10. What is the object of the twine-box tension?

11. What is meant by a standard cylinder?

12. How many rows of concave teeth should be used for threshing—wheat, barley, oats, flax and timothy?

13. Describe the construction of the straw rack.

14. How is the blast in the fanning mill adjusted as to the amount and direction?

15. How will the condition of the tailings indicate how the threshing machine is working?